

# Comments on Climate Change & Water Infrastructure

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for WATER BOARDS WATER QUALITY COORDINATING COMMITTEE MEETING  
on Oct 25, 2017

## Topics

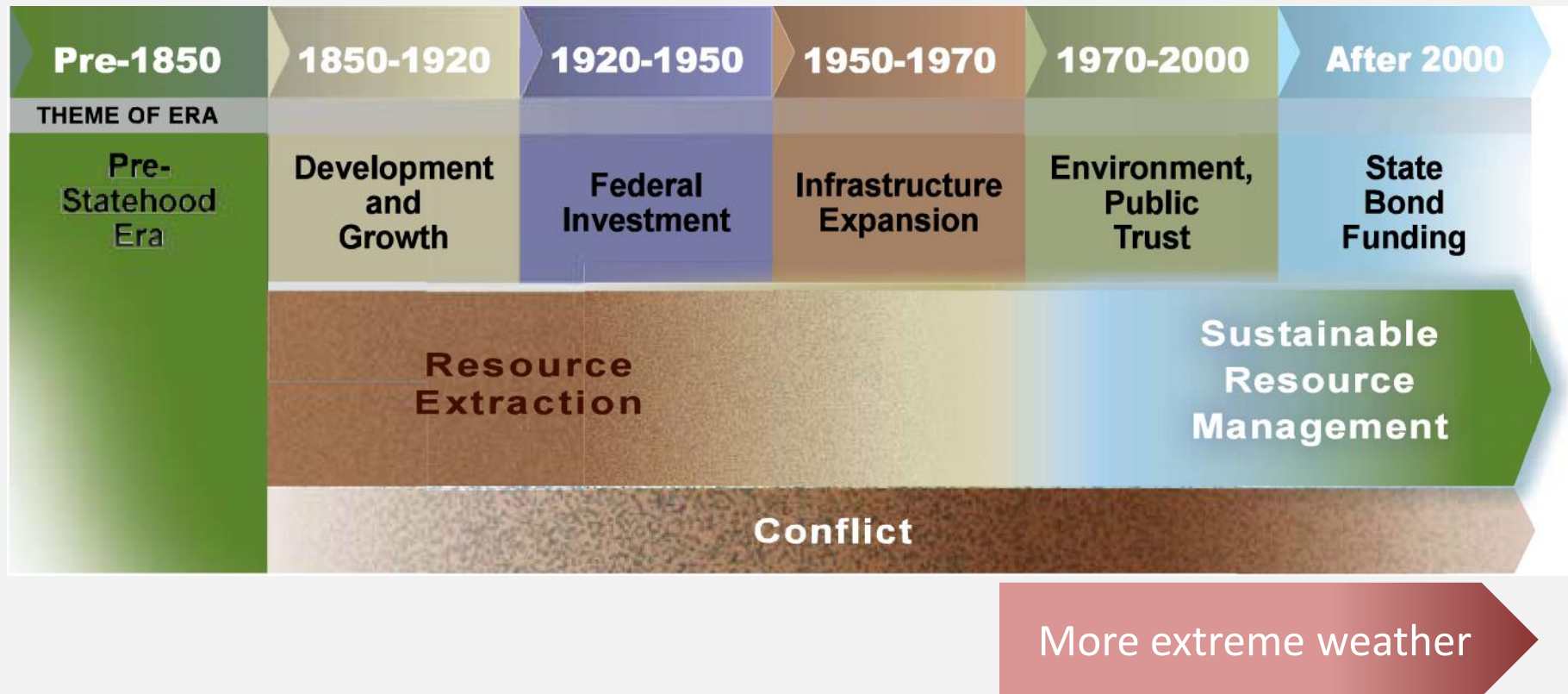
- Infrastructure planning & operation in a changing climate
- Water data & information as critical infrastructure



NSF Southern Sierra  
*Critical Zone Observatory*



# Moving toward sustainability in a changing climate



Some questions w/ infrastructure implications:

- Depletion vs. sustainability of groundwater
- Level of sustained water supply
- Water storage

# 1100 yr drought record

Reconstructed flows  
of San Joaquin R.  
Color shading marks  
below-median  
periods 4+ yr long  
1-6 per century

Multi-year dry periods are part of our  
Mediterranean climate



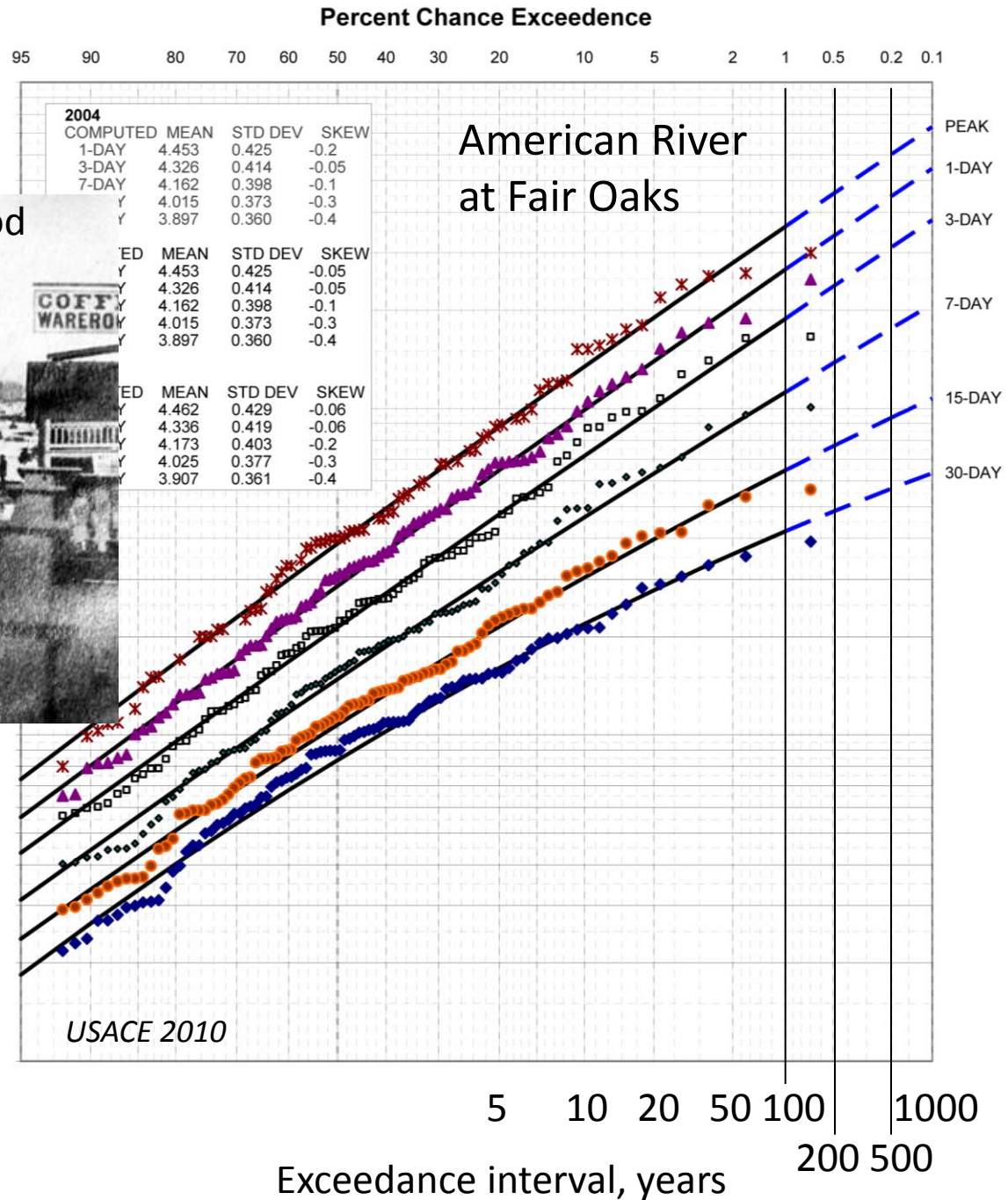


# American River flood frequency

1861-62 Sacramento flood

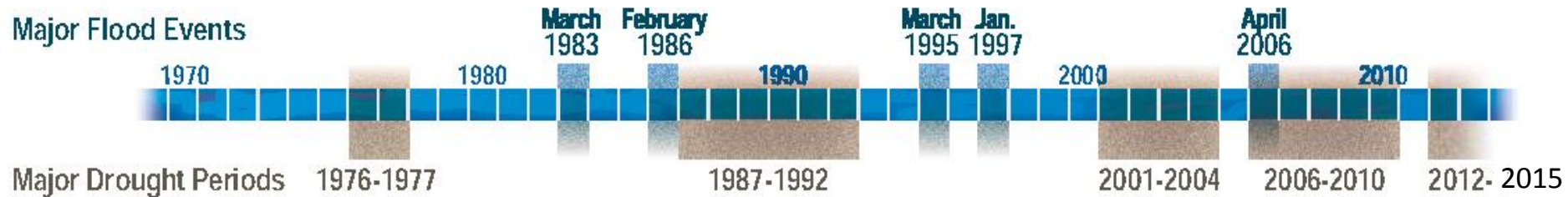


Credit: USGS



How will this change  
w/ climate warming?

# Multi-year droughts vs. floods in California

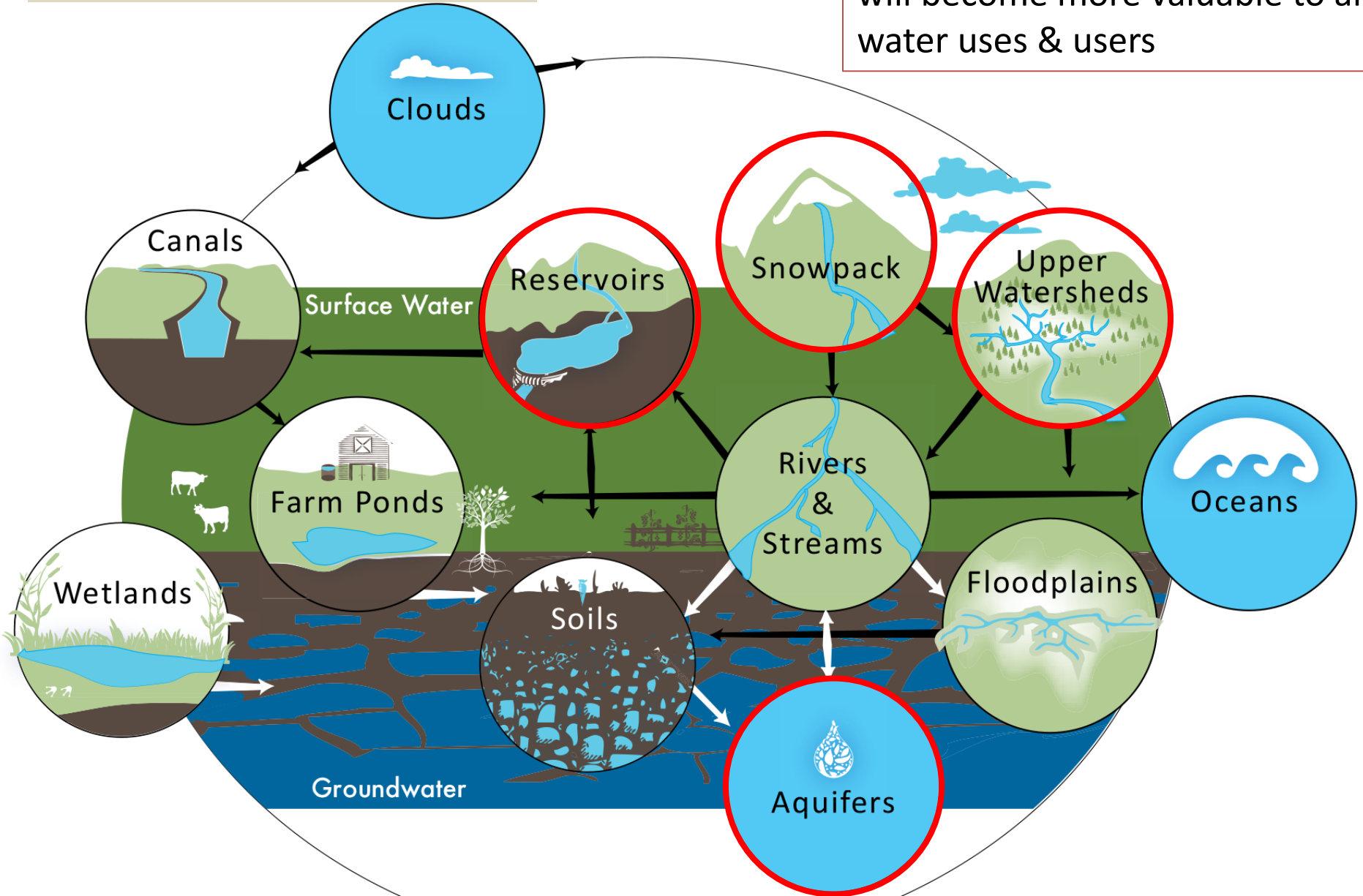


Five multi-year (2+) dry periods since 1970  
Ten since 1915

Storage is key to water security in a highly variable climate

# Water storage reservoirs

In a warming climate, storage will become more valuable to all water uses & users



# Planning scenarios under changing hydrology

Extremes are not  
what they used to be

Storage, reoperation & climate change (DWR):

- Optimize use of existing facilities & groundwater storage
- Manage for extremes 

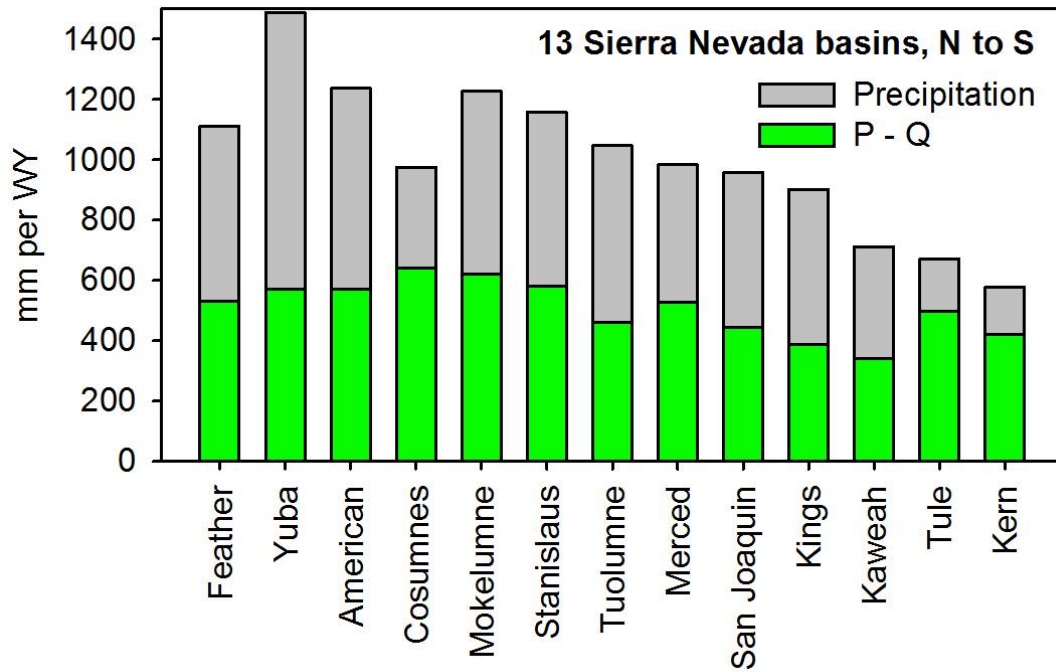
Some thoughts:

1. Use multiple approaches & sources for hydrology in a warmer climate
  - Climate models coupled w/ hydrologic models are just one
2. Focus on extremes vs means for scenarios
  - Evapotranspiration is also changing



# Evapotranspiration

We can measure & manage evapotranspiration on a basin-wide basis



Precipitation =

Runoff +

Evapotranspiration



# Century-long experiment: suppressing fire

1896

Kyburz, S. Fork American R., 5000'

1993

We now know this was a bad idea; and sustainable solutions remain elusive

*Photos from G. Gruell*



A photograph of a forest landscape. In the foreground, there is a dense forest of evergreen trees, some of which appear to be dead or dormant, showing brownish-orange hues. In the background, there are rolling hills and mountains, also covered in forest, with some areas appearing more brown and sparse. The sky is overcast with grey clouds. A semi-transparent yellow box is overlaid on the top left, and a semi-transparent dark grey box is overlaid in the center, both containing text.

## Multi-year experiment: drought

Widespread drought-induced mortality in  
rain zone of Southern Sierra pine-oak forest



## Interpretation


### Parts of the Southern Sierra forest reached a tipping point



Multi-year subsurface storage critical for drought resiliency in  
headwater forests

Forest densities are higher than can be sustained through historical  
droughts in a warmer climate



A photograph of a massive wildfire in a forest. Bright orange and yellow flames are visible through the trees, with thick white smoke rising. In the foreground, a black cow stands on the left, a firefighter in full gear stands in the center, and a red fire truck is on the right. The scene is set in a grassy field with tall evergreen trees in the background.

Source-water areas will increasingly experience disturbance by wildfire, forest mortality or both

Rim Fire, 2013



A photograph of a forest with large trees and a person in the background. The forest floor is covered in brown pine needles and branches. Several large, mature trees with thick trunks are visible. A person wearing a yellow hard hat and a green jacket is walking in the background. The text "Management response: restore (thin) forest → reduce ET" is overlaid in yellow.

Management response:  
restore (thin) forest → reduce ET

**Thinned unit w/ control in background**



## Social aspects of climate change

Planning for extremes is a climate-communications opportunity, to build support for investments in water infrastructure, & policy

Findings from a UC study: **TomKat Communication Working Group Report: Strategic Communication to Achieve Carbon Neutrality within the UC**

- Most members of the UC community feel that climate action is important
  - shared values around concept
- There are always competing priorities for investment; & creative approaches are available
- Transparency & data are key to awareness of UC community
- Actions proposed should be consistent w/ core research & teaching mission

## Making a water-secure California – the three I's

### **INFRASTRUCTURE**

to store, transport  
& treat water

Stronger & more-

adaptable

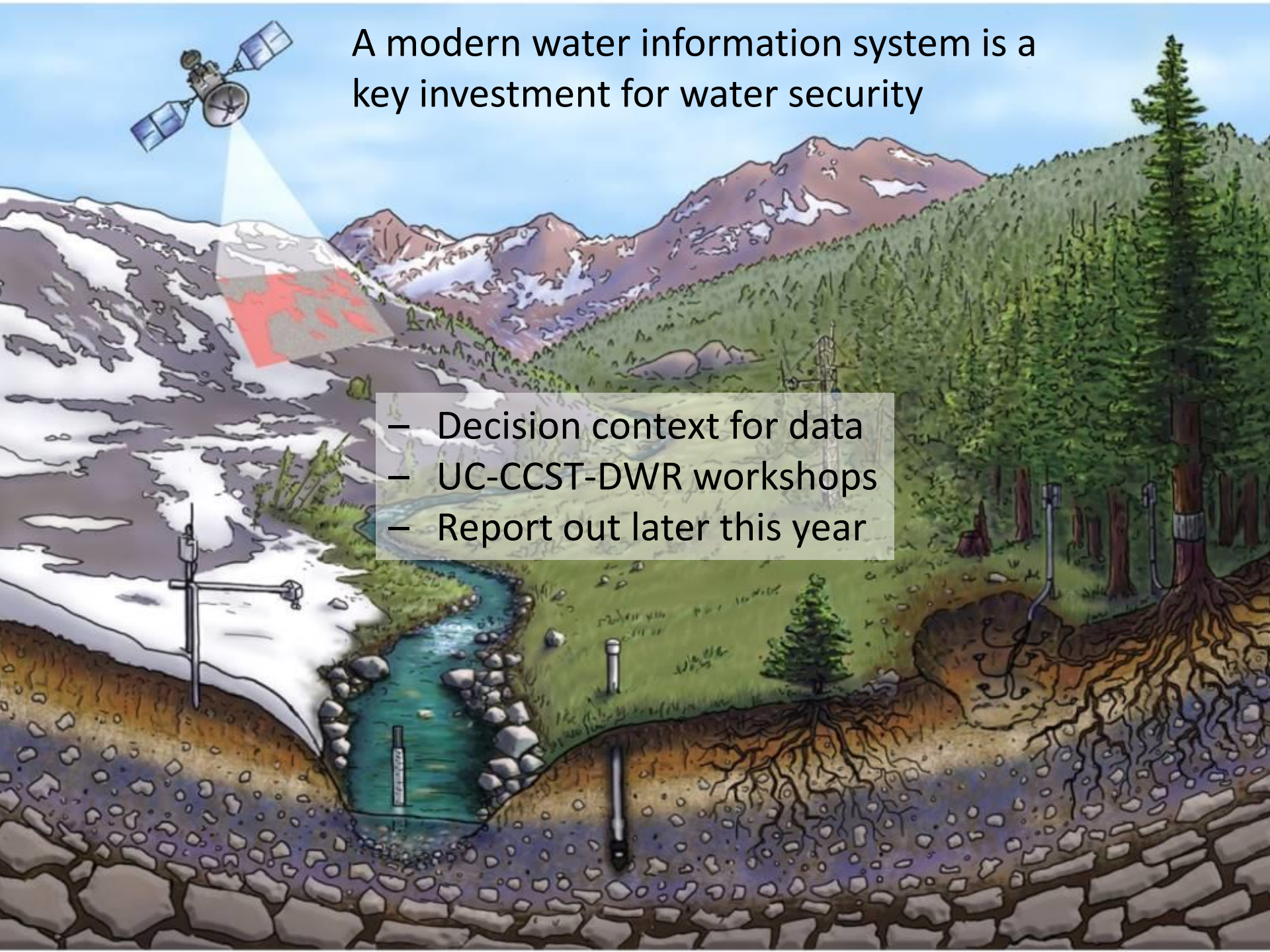
### **INSTITUTIONS**

Water security lies at the heart of adaptation to climate change

Better & more-  
accessible

### **INFORMATION**

Water security: the reliable availability of an acceptable quantity & quality of water for health, environment, livelihoods & production, coupled w/ an acceptable level of water-related risks



A modern water information system is a  
key investment for water security

- Decision context for data
- UC-CCST-DWR workshops
- Report out later this year